

REMARKS

Claims 1, 2 and 5 remain pending in the application.

Claim Amendments

Claim 1 is amended to lower the upper limit for the polymerization temperature range from 200 °C to 170 °C. Support for this amendment resides at page 59, line 24 of the specification. No new matter is added by this amendment.

Objection to Claim 1

The Examiner questions whether the geometry of certain substituents on the catalyst permits formation of the recited aromatic ring.

In response, applicants state that the requisite aromatic ring can be formed between, for example, substituents R¹ and R² because the recited formula includes the feature where the ortho position in the quinoline skeleton is substituted with Y, and then Y and M are covalently bonded to form a complex structure where N is coordinated with M.

Further, the Examiner states that the ring would no longer be aromatic upon reduction. However, the components (A), (B-1) and (B-2) recited in claim 1 are precursor components and not post-catalyst formation components.

In view of the above, the claim language is correct and the objection should be withdrawn.

Rejection under 35 USC 103(a)

Claims 1, 2 and 5 stand rejected under 35 USC 103(a) as being unpatentable over JP 11-199592. This rejection respectfully is traversed to the extent deemed to apply to the claims as amended.

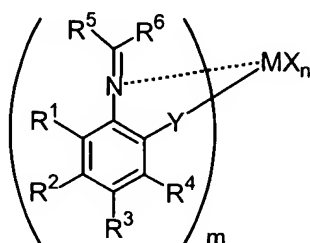
As previously discussed, the cited reference discloses a transition metal compound A of formula I (as defined) and a catalyst comprising

- (A) the compound of formula I
- (B) at least one of a compound selected from
 - (B-1) an organometal compound,
 - (B-2) an organoaluminum oxy-compound, and
 - (B-3) a compound which reacts with the transition metal compound (A) to form an ion pair, and
- (C) a carrier.

The above compounds will hereafter be referred to as (a), (b-1), (b-2), and (b-3) to avoid confusion with the recited components in applicants' claimed compound.

Applicants' claimed invention is directed to a polymerization process which occurs at a temperature of 50 to 170°C by use of a polymerization catalyst consisting essentially of

- (A) a transition metal compound represented by the following formula (I),



(I)

(B-1) an organoaluminum compound having reducing ability which reacts with the transition metal compound (A) to convert an imine structure moiety to a metal amide structure, and

(B-2) a compound which reacts with the transition metal compound (A) to form an ion pair, and

wherein the catalyst activity is at least 1000 kg polyolefin/mole transition metal atom·hr.

In the claimed invention, the particular combination of the compounds (B-1) and (B-2) together with the transition metal compound (A) of the formula (I) is recited in order to yield a catalyst having the requisite polymerization activity at a specified polymerization temperature range of 50-170°C whereby surprisingly elevated polymerization activity within the range is achieved.

The reference discloses a broad range of catalyst compounds, but does not in any way teach or suggest the specific combination of compounds (B-1) and (B-2), together with the selected transition metal compound (A), as defined in applicants' claim 1.

More specifically, the claimed compound (B-1) in the catalyst is distinguishable from the catalyst compounds of the cited reference, since compound (B-1) is used together with compound (B-2).

As previously argued, the reference discloses various combinations of the catalyst compounds, but when the reference uses compound (b-3) (which corresponds to applicants' claimed compound (B-2)), only the following combinations are taught:

- (1) none of both (b-1) and (b-2)/(b-3)
- (2) (b-1) (organometal compound)/(b-3)
- (3) (b-2) (organoaluminum oxy-compound)/(b-3)
- (4) (b-1)/(b-2)/(b-3)

Of the above combinations, (1), (3) and (4) are not relevant to the claimed combination of (B-1) and (B-2) because compound (B-1) of the invention excludes the organoaluminum oxy-compound used in the reference. However, the combination of the compounds of the reference (b-1) and (b-3) in combination (2) above is identical to the specific combination of (B-1) and (B-2) of applicants' claimed compounds.

It is again noted that Example 5 of the reference teaches a compound C-3 used as transition metal compound (A), triisobutyl aluminum ($i\text{Bu}_3\text{Al}$, TIBA) is used as organoaluminum compound (B-1), and triphenylcarbeniumtetrakis(pentafluorophenyl) borate is used as a compound forming ion pair (B-3). However, compound (C-3) is outside the scope of the claimed invention.

By use of the specific catalyst system used in the claimed process, an olefin polymer can be produced under dramatically high polymerization activity at high temperatures (50 °C or higher) as defined in claim 1. Such unexpected results are demonstrated in applicants' examples.

Compound (C-3) having an Ni-S bond is used as the transition metal compound (A) and $i\text{Bu}_3\text{Al}$ is used as the organometal compound (B-1) in Example 5 of the reference. The reason for the use of $i\text{Bu}_3\text{Al}$ in the Examples of the reference is not due to any expected reduction activity, but it is common knowledge to use trialkyl aluminum when a compound having a transition metal-halogen bond is present such as in compound C-3. A copy of page 1414 of *Chem. Rev.* 2000, 1391-1434 was previously provided to the Examiner to confirm this teaching of the prior art.

Taking the teachings of Example 5 as well as the remaining teachings of the reference into account, it is clear that attaining a significantly high polymerization activity at high temperature by use of a polymerization catalyst having a compound forming an ion-pair (B-3) in combination only with a compound **having a C=N bond** selected from transition metal compounds (A) and only with an organoaluminum compound having reduction ability selected from organometal compounds (B-1) is quite difficult.

The cited reference does not teach or suggest the claimed *polymerization process* using the specifically recited catalyst.

Indeed, applicants' claims are directed to a polymerization process conducted at a temperature in the range of from 50 to 170°C, and not to a polymerization catalyst *per se*. While the reference teaches the use of a polymerization temperature in the range of 0 to 170°C, the examples of the reference all recite the use of a polymerization temperature of 25°C. See previously-submitted translations of Examples 5 and 7, for instance.

By contrast, the instant Examples employ polymerization temperatures of 50, 75 and 80°C. The reference thus not only fails to appreciate the advantages of the claimed invention, but teaches away from polymerization temperatures of the order used by applicants.

The previously-submitted Declaration under 37 CFR 1.132 demonstrates the advantages attained by the claimed method.

More specifically, experiment A was carried out in the same manner as in Example 5 of the cited reference, except that the polymerization temperature was raised from 25°C to 50°C.

Experiment A shows that the polymerization activity at 50°C was 36.8g-PE/mmol-V·hr - the polymerization thus does not proceed at all due to the fact that the transition metal compound (A) of Example 5 does not meet the claimed limitation of having an N=C bond (and which also contrasts with applicants' claimed catalyst activity recited in claim 1).

In addition, a comparison between Example 1 and Comparative Example 3 clearly shows that the polymerization does not proceed in the case wherein the organoaluminum compound (B-1) is trimethylaluminum which does not exhibit the requisite reducing ability to convert the amine moiety to a metal amide.

The Examiner's attention is directed to the results of Example 5 of the reference, additional Experiment A, Example 1 of the present invention, and Comparative Example 3 summarized in the following table:

	Temp. (°C)	Time (hr)	(A) transition metal compound (mmol)	(B-1) organo- aluminum compound (mmol)	(B-2) compound forming ion pair (mmol)	Polyme- rization activity g-PE/mmol·M· hr
Ex.5 of JP'592	25	1.0	(C-3) (N-Si bond) :0.005	TIBA:0.25	Tr-B:0.006	12
Exp.A	50	1.0	ditto	ditto	ditto	36.8
Ex.1 (inven- tion)	50	0.5	(C-1) (N=C bond) :0.005	ditto	ditto	1405
Comp. Ex.3	50	0.5	ditto	Trimethyl- Aluminum :0.25	ditto	107

As is apparent from the table, only the claimed combination of species (A), (B-1) and (B-2) demonstrate the requisite high polymerization activity, which is orders of magnitude higher than the comparison examples.

Thus, while the Examiner takes the position that applicants' invention can be derived from the "best" combinations of the disclosed combinations, applicants have demonstrated that the "best" combination of components is not the result of an obvious choice, but is instead the result of an unobvious choice. Clearly, one of ordinary skill in the art lacks the requisite

motivation to arrive at the claimed invention upon review of the disclosure of the reference.

Applicants again note that the Declaration demonstrates that the polymerization activity of Example 1 of the invention is 1405 g-PE/**mmol**-M·hr (corresponding to 1405 kg-PE/**mol**-M·hr).

By contrast, the activity of Example 5 of JP '592 is 12k-PE/**mmol**-M·hr at 25 °C (corresponding to 12kg-PE/**mol**-M·hr at 25 °C), while the activity of Experiment A is 36.8kg-PE/**mmol**-M·hr at 50 °C (corresponding to 36.8k-PE/**mol**-M·hr at 50.0 °C), each of which is orders of magnitude below the minimum of 1000kg-PE/**mol**-M·hr **required by claim 1.**

As previously acknowledged by the Examiner, the activity of Experiment A is higher than that of Example 5 of JP '592.

However, even at the same temperature of 50 °C, the activity of inventive Example 1 is far higher than Experiment A, although the transition metal (M) is titanium in inventive Example 1 but vanadium in Experiment A.

In this regard, it is noted that when the transition metals titanium and zirconium are used in Examples 1-4 of JP '592, the resulting activities are 12 g-PE/**mmol**-Ti·hr (Ex. 1) and 44 g-PE/**mmol**-Zr·hr (Ex. 2). These activities are almost identical to the activity of Example 5 of JP '592 using vanadium, and are far lower than the claimed range of 1000 kg-PE/**mol**-M·hr (wherein M is a transition metal).

Thus, it is clear that the surprising effect upon activity of at least 1000 kg-PE/**mol**-M·hr may be realized by practice of

the claimed invention based on the recited combination of organoaluminum (B-1) and a compound which reacts with a transition metal component (B-2).

In summary, no teaching resides in the cited reference which would lead one of ordinary skill in the art to conduct a polymerization process within the recited temperature range using a catalyst containing the component (B-1) having reducing ability selected from the group consisting of organometal compounds (b-1) of the reference, in combination with components (B-2) and the transition metal component (A), with the resulting effectiveness on polymerization activity at high temperature being attained. Applicants accordingly submit that, not only has the Examiner not presented a *prima facie* case of obviousness, but any *prima facie* case of obviousness that may have been presented has been rebutted by applicants.

In view of the above, it is submitted that rejection is without basis and should be withdrawn.

The application is accordingly believed to be in condition for allowance.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a two month extension of time for filing a reply in connection with the present application, and the required fee of \$420.00 is attached hereto.


If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional


Application No. 10/009,738

fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17;
particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By 
Raymond C. Stewart, #21,066
P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000


RCS/JWH/sh
1155-0234P